Measurement	n	Mean	LCI	UCI	Min	Max	F	p
Wing length	245	-1.5	-1.67	-1.33	-2.14	-1.15	4.45	0.0017
Bill length	225	-4.67	-5.44	-3.91	-8.28	2.72	50.43	0.0000
Tail length	240	-5.06	-5.4	-4.72	-6.03	-3.8	6.36	0.0001
Tarsus length	210	1.77	1.3	2.25	1.22	2.16	0.47	0.7566

Table 2: Shrinkage rate for different measurements. Confidence intervals (95 %) around means are given (LCI, UCI); the range of means is calculated for each observer separately (Min, Max); F statistics and its significance for the null hypothesis, that there is no difference in shrinkage rate between observers.

Research performed in museum collections is very attractive because material is easily available. But many problems may arise. For example, Slagsvold & Skipnes (1982) analysed corvids in Norwegian museums and found that 85 % of all birds were sexed, but data on body weight existed only for 36 % of the specimens. Sometimes, museum specimens were sexed wrongly, and birds with different kinds of abnormalities seemed to be over-represented in the museum collections (e.g. albinos).

One of the most discussed problems is skin shrinkage after preparation. In our study of great grey shrikes we observed a mean shrinkage of ca. 5 %, depending on measurement. This value is rather high in comparison with values in other studies on waders and passerines (1 – 4 %, cf. Vepsäläinen 1968; Knox 1980; Bjordal 1983). However, the data of these authors were obtained from relatively small sample sizes and in short time after preparation. The time between bird collection with first measurements and the second measurement for the evaluation of shrinkage was as long as 16-42 years, what is fairly more than in other studies. Since we do not know the correlation between shrinkage and time and we do not know whether different taxa show the same shrinkage, there is another serious problem when we use skins from museum collections.

We suggest the following recommendations for the improvement of measurements obtained from skin material:

- It is recommended to exactly define the method of measurement taking.
- Within one study, measurements should be taken by one person.
- Skin age should be included into the analysis as a covariant to avoid biases due to shrinkage.

ACKNOWLEDGEMENTS

We thank Tomáš Jaszay, the Curator of Natural History Collection of Šarriské Museum, Bardejov for the loan of museum specimens. We are also grateful to Ivka Hromadová for improving the English and for comments on the manuscript.

LITERATURE

Becker, W. A. (1992): Manual of Quantitative Genetics. Academic Enterprises, Pullman, Washington, 192 pp.

Bjordal, H. (1983): Effects of deep freezing, freeze-drying and skinning on body dimensions of House Sparrows *Passer domesticus*. Fauna norv. Ser. C. Cinclus **6**: 105-108.

Bub, H. (1981): Kennzeichen und Mauser europäischer Singvögel, 2. Teil Stelzen, Pieper und Würger (Motacillidae und Laniidae). Ziemsen Verlag, Wittenberg Lutherstadt.

Busse, P. (1983): Biometrical standards in the Operation Baltic. Ring **116**: 125-138.

Cramp, S. & Perrins, C. M. (eds.) (1993): The Birds of the Western Palearctic. Vol. 7. Oxford University Press, Oxford.

Engelmoer, M. & Roselaar, C. S. (1998): Geographical variations in waders. Kluwer Academic Publishers, Dordrecht.

Evans, P. R. (1964): Wader measurements and wader migration. Bird Study **11**: 23-38.

Gosler, A. G., Greenwood, J. J. D., Baker, J. K. & Davidson, N. C. (1998): The field determination of body size and condition in passerines: a report to the British Ringing Committee. Bird Study **45**: 92-103.

Haftorn, S. (1982): Variation in body measurements of the Willow Tit *Parus montanus,* together with a method for sexing live birds and data on the degree of shrinkage in size after skinning. Fauna norv. Ser. C. Cinclus **5**: 16-26.

Helm, B. & Albrecht, H. (2000): Human handedness causes directional asymmetry in avian wing length measurements. Anim. Behav. **60**: 899-902.

Hogstad, O. (1983): Wing length variation and movement pattern of the Three-toed Woodpecker *Picoides tridactylus* in Fennoscandia. Fauna norv. Ser. C. Cinclus **6**: 81-86.

Knox, A. (1980): Post-mortem changes in wing lengths and wing formulae. Ring. Migr. **3**: 29-31.

Lefranc, N. & Worfolk, T. (1997): Shrikes. A guide to the Shrikes of the World. Pica Press, Sussex.

Panov, E. N. (1995): Superspecies of shrikes in the former USSR. Proc. West. Found. Vert. Zool. **6**: 26-33.

Schön, M. (1998): Zur Evolution der parapatrischen nördlichen und südlichen Raubwürger, *Lanius [excubitor]*, in der Gruppe der Großen Grauwürger (Aves: Passeriformes: Laniidae). Von morphologischen Unterscheidungen über funktionale Betrachtung auf ökologische Unterschiede schließen – und umgekehrt? Zool. Abhandl. Staat. Mus. Tierkd. Dres. **50** Suppl.: 145-153.

Slagsvold, T. & Skipnes, K. (1982): How representative of bird populations are specimens in museum collections: data on Norwegian Corvids. Fauna norv. Ser. C. Cinclus **5**: 27-35.

Sokal, R. R. & Rohlf, F. J. (1995): Biometry. Freeman, New York, 887 pp.

Szulc, B. (1964): A tentative assessment of certain morphological measurements used in ornithology. Ekol. Pol. B, 10: 19-25.

Vepsäläinen, K. (1968): Wing length of Lapwing *(Vanellus vanellus)* before and after skinning, with remarks on measuring methods. Ornis Fennica **45**: 124-126.

Lechosław Kuczyński, Maciej Skoracki, Department of Animal Morphology, Institute of Environmental Biology, Adam Mickiewicz University, 28 Czerwca 198, PL-61-485 Poznań, Poland

Piotr Tryjanowski, Department of Avian Biology & Ecology, Institute of Environmental Biology, Adam Mickiewicz University, Fredry 10, PL-61 701 Pozna , Poland, corresponding author, e-mail: ptasiek@amu.edu.pl

Marcin Antczak, Department of Zoology, University of South Bohemia, Branišovská 31, CZ-370 05 eské Bud jovice, Czech Republic

Martin Hromada, Department of Natural History, Šarišské Museum, Radni né nám. 13, SK-085 01 Bardejov, Slovakia

Bonner zoologische Beiträge	Band **51** (2002)	Heft 2/3	Seiten 131-135	Bonn, September 2003

Bird Collections – an Essential Resource for Collecting Ectoparasites, in Particular Chewing Lice

Eberhard Mey

Naturhistorisches Museum of the Thüringer Landesmuseum Heidecksburg Rudolstadt

Abstract. On study skins of birds, prepared in traditional manner (i.e. without washing), one can find traces (often in considerable numbers) of their former ectoparasitical occupants. Besides mites and ticks, it is above all the chewing lice (Insecta, Phthiraptera: Amblycera and Ischnocera) that remain in mummified form on skins. Their eggs can be found in particular feather tracts. This fact has been known at least since the beginning of the 19th century and has been well exploited by many collectors, especially those interested in chewing lice. The material gathered by this method forms a basis of our current knowledge of the occurrence and distribution of chewing lice that parasitize birds of all orders. This method, briefly outlined here, does of course contain sources of error. The authenticity of the material is high if contamination with parasites from other hosts can be excluded. Despite this, the technique of shaking out study skins remains an effective way of studying the diversity of these host-specific insects, most of which are only 2-4 mm in size. At present, c. 1200 species of Amblycera and c. 2700 of Ischnocera are known from birds. The number of undescribed chewing lice forms is estimated to be around 4000. Chewing lice are normally highly host specific. Therefore we may expect that skins of extinct bird species will yield specimens of also extinct chewing lice forms, and occasionally other host-specific ectoparasites. For these reasons bird collections possess a high importance for scientific disciplines outside ornithology

Key words. bird collections, chewing lice, collecting techniqu, extinct phthirapteran taxa

1. INTRODUCTION

Bird study-skin collections have not been assembled by museums in order to later examine the specimens for the occurrence of ectoparasites. For this purpose, the examination of live, freshly collected and/or prepared birds is always more rewarding, and especially regarding the authenticity of the study material it is fundamentally the preferred method. In the relatively straightforward spectrum of ornithophilous ectoparasites (a diverse array of mite groups, ticks, bugs, louse-flies, fleas), the feather mites (Acari: Analgoidea) and in particular the chewing lice (Insecta, Phthiraptera: Amblycera and Ischnocera, which alone will be treated here), occupy a special place because of their commonness. This applies only to these two groups even if they are collected from skins in scientific collections. For at least 200 years this situation has been exploited by the small band of dedicated feather lice specialists. At present, and for the foreseeable future, this remains an indispensable and effective way of harvesting from the tremendously concentrated resource of bird skin collection material that is generally difficult to obtain. The need for research is as great as ever. Considering the present expanding interest in systematics and biodiversity, well catalogued bird collections are gaining an importance which, if not exactly new is at least greater than in the past. This importance is here examined in detail. I know from my own experience over many years (Table 1) that the hidden potential of these traditional repositories in the form of 'accidentally' con-

Table 1: Bird study-skin collections partially examined since 1978, mostly by the author, in order to gather chewing lice material.

Basel, Naturhistorisches Museum	Halberstadt, Museum Heineanum
Berlin, Naturkundemuseum	Halle/Saale, Zoologisches Institut
Bonn, Museum Alexander Koenig	Hamburg, Zoologisches Institut und Museum
Bremen, Übersee-Museum	Karlsruhe, Landessammlungen für Naturkunde
Dresden, Staatliches Museum für Tierkunde	Leiden, Nationaal Natuurhistorisch Museum Naturalis
Funchal, Museu Municipal (Hist. Nat.), Madeira	Leipzig, Naturkundemuseum
Frankfurt am Main, Senckenberg-Museum	Munich, Zoologische Staatssammlung
Görlitz, Naturkundemuseum	Rudolstadt, Naturhistorisches Museum
Gotha, Museum der Natur	Stuttgart, Museum für Naturkunde
Greifswald, Zoologisches Institut	Wrocław, Zoologisches Institut

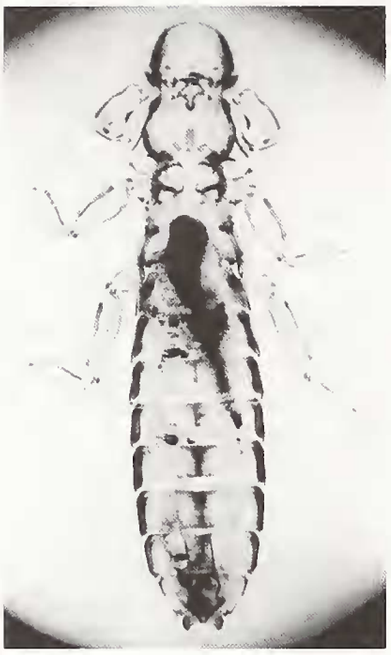

Fig. 1: Ischnoceran chewing louse, *Megathellipeurus parkeri* (EMERSON & PRICE), shaken from the over 100-year-old study skin of a Malleefowl *Leipoa ocellata* in the Berlin Naturkundemuseum. During collecting it often happens that bristles, legs, antennae, and/ or other parts of the brittle mummified insects break off.

Photo: H. Reubke.

served parasitical arthropod species is often ignored by many museums, despite the recognition of their important status as bird collections.

2. CHEWING LICE – FASCINATING INSECTS

Chewing lice (Fig. 1) are insects on average 2-4 mm in length, which are highly adapted to life on the integument of their host, and which never leave these hosts (a single species) during their brief lives; in other words they are extremely host-specific. They are highly unlikely to be absent on any recent bird species, even if they are as yet completely unknown for some families (e.g. Todidae, or Picathartidae and some other passerines). This extreme host specificity of chewing lice has led to the realization that their evolution has paralleled that of their hosts, at least since the end of the Cretaceous Period, resulting in cospeciations. This hypothesis is utilized by parasitophyletic studies in the search for evidence useful in the clarifying of taxonomic relationships between particular host groups.

Chewing lice belong to the order of the animal lice Phthiraptera and can be separated into two distinct suborders. The Amblycera (1183 species so far identified) and the Ischnocera (2683 species) are known from all avian orders (CRUICKSHANK et al. 2001). I estimate that the number of undescribed chewing lice forms is around 4000.

Against this background, chewing lice deserve special attention, particularly on the part of museum ornithologists who should be aware of the scientifically valuable material that is 'slumbering' in the bird study-skin collections in their care in the inconspicuous form of mummified chewing lice.

3. EXAMINATION AND TREATMENT OF BIRD STUDY SKINS

It is a mistaken assumption that following the death of a host all its chewing lice attempt to leave the corpse. If the opportunity to transfer to another host is lacking, the majority are forced to stay where they are. They are able to survive for some days but eventually die. The Ischnocera remain on the feathers that are tightly gripped in their powerful mandibles, while the Amblycera are close to the skin of the host, their thick coating of bristles ensuring that they are fairly well anchored in the body plumage. Both of these situations however do not necessarily apply to all members of the chewing lice population on a host individual. Many of the Amblycera actively move to leave the host, a behaviour that perhaps explains why considerably more Ischnocera than Amblycera are recorded on study skins. Nevertheless, experience shows that despite the loss of part of the Ischnocera and/or Amblycera fauna caused by the preparation procedure, a profitable fraction usually remains on the (unwashed) skin.

The methodology of the removal of ectoparasites from bird study skins has been described by EICHLER in several publications, especially in his work of 1971. It is a simple process and as long as the skins are responsibly treated is highly recommended (Figs.

Fig. 2: Wing feathers and tail feathers are moved lightly against each other and the body feathers loosened with the fingers. This usually causes the first mummified chewing lice to fall from the plumage. Gentle shaking or patting of the skin will increase this number. The head plumage should be examined feather by feather, and also for chewing lice eggs (nits), using tweezers.

Photos: W. Kluh

Fig. 3: The mummified chewing lice are placed in a meticulously labelled collecting tubule using a fine paintbrush. The dark-coloured adults can be more or less easily picked out among the 'precipitation' of dust, powder, detritus, tow, and often single feathers. Those lice that are whitish in colour and less than 1 mm in size have to be searched for with particular care.

Photo: W. Kluh

2-4). There are two stages in the operation and they can be carried out separately or in combination:

1. The purposeful feather-by-feather examination of specific areas, particularly on the head including the base of the bill, using tweezers; this is sometimes done to firstly establish the presence of eggs (nits) in order to be sure that there is a chance of finding chewing lice on the skin (Fig. 5). This intensive searching method is suggested for small birds up to about *Turdus merula* size.
2. The careful patting of the skin after the plumage has been loosened. This is the best method for species roughly larger than *Turdus merula*. This extensive examination can be carefully repeated several times with one skin.

The study skins thus treated are held over a smooth white sheet of paper or plastic and the resulting mummified chewing lice preserved in dry collecting tubules.

Fig. 4: Utensils used in obtaining ectoparasites, principally chewing lice, from dry bird study skins. – Photo: E. MEY.

When labelling, it is of crucial importance that the correct host name is recorded (EICHLER 1970). One occasionally comes across finds from study skin collections whose authenticity has to be doubted (e.g., when shorebird chewing lice are found on a pigeon). Therefore when evaluating material obtained from study skins it is always necessary to employ a skeptical approach and not to jump to hasty conclusions.

Fig. 5: The confirmation of nits, usually in the head plumage, is a sure indication of chewing lice infestation. An unusual case is shown here, where the eggs and clutch of *Hohorstiella ectootoca* MEY are attached to the dorsal feather tips of a Blue-headed Quail-dove *Starnoenas cyanocephala* and are thus externally visible. After MEY (1984).

4. SOME RESULTS FROM BIRD STUDY SKIN EXAMINATIONS

Just how successful examination of skin material carried out using the combined 'shaking out and patting' method can be has been impressively demonstrated, quantitatively as well as qualitatively, by WARD (1957 a,b) in the case of the tinamous. It has to be said that the chewing louse fauna of the Tinamiformes, compared with all other orders of recent birds, has by far the highest diversity at ca. 200 species. This was confirmed by WARD (l.c.) inasmuch as he was able to obtain from several skins of one *Crypturellus* subspecies alone 12 Ischnocera species, and a maximum of 9 from only a single skin of the same subspecies. He found several thousand mummified chewing lice on a total of 1500 skins of 130 tinamou species and subspecies. Of the 20 chewing lice genera identified (using the most conservative classification), 18 infest only tinamous. According to WARD's (1957a) findings, the host distribution of the chewing lice recorded does reflect the classification of the Tinamidae by von BOETTICHER (1934) in Tinaminae, Rhynchotinae, and Eudromiinae. In addition, he was able to make fundamental taxonomic and ecological statements concerning tinamou chewing lice.

However, it is only with a great amount of effort that we will be in a position to present similar results for